THE APPLICATION OF A "PURPLE NON-SULFUR BACTERIA BIO-AUGMENTATION SCHEME" TO ENHANCE THE PROCESS DURABILITY, THE BIODEGRADATION EFFICIENCY, AND ENERGY-CAPTURE IN ANAEROBIC DIGESTION PROCESSES

By

Mostafa Shafik Hammam

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
Civil Engineering - Public Works

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Under the Supervision of

Prof. Dr. Khaled Z. Abdalla
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Title of Thesis:
The Application of a "Purple non-Sulfur Bacteria Bio-augmentation Scheme" to Enhance the Process Durability, the Biodegradation Efficiency, and Energy-Capture in Anaerobic Digestion Processes

Key Words:
Rhodobacter capsulatus; biogas; organic load assimilation capacity; anaerobic reactor illumination; paired reactors

Summary:
The Purple non-sulfur bacterium, Rhodobacter capsulatus "ATCC ® 11166™" strain, was utilized for inoculating two semi-pilot scale anaerobic digestion reactors, within a configuration comprising five semi-pilot scale reactors. The investigation assessed the effect of applying a proposed bio-augmentation scheme onto anaerobic digestion with respect to biodegradation efficiency, resilience, and energy capture efficiency. Analyses provided significant evidence of the positive impact of the proposed scheme onto the biodegradation efficiency of the bio-augmented reactors. Also, a significant increase in hydrogen content that averaged 3.5% was observed within yield biogas which also exhibited an average volume increase of about 12%. The bio-augmented reactors were also subjected to a set of typically perturbation-causing conditions, with the results demonstrating the superior resilience of operation within the bio-augmented reactors, compared to other reactors. The results emphasized the importance of the proposed scheme in mitigating the severity of some bottlenecks that are typically associated with anaerobic digestion.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

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Dedication

To my late father, Prof. Dr. Shafik Hammam…
He was, and will always be, my motivation in life.

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Cairo

Mostafa Shafik Hammam ***August 2019***

Table of Contents